Project acronym: FROSTROOT

Project title: The role of deep-rooting plant species for carbon and nitrogen cycling in thawing permafrost ecosystems

Project leader: Ellen Dorrepaal, Umeå University, Sweden

Discipline: Earth Sciences & Environment: Ecosystems & Biodiversity

Station(s): Toolik Field Station (USA)

Permafrost contains large amounts of soil organic carbon (SOC) and nitrogen (N), situated underneath the seasonally-thawing active layer. Climate-warming and thawing-induced N release at the thaw-front is therefore only accessible to deep-rooting plant species and may stimulate their CO2-uptake. At the same time, deep roots may act as microbial vectors for downwards transfer of active-layer microbes into newly thawed permafrost, where such exogenic communities might stimulate SOC-degradation. Interactions between plants, microbes and thawing soil thus play a critical but poorly understood role in the permafrost-climate feedback. We aim to understand over what time scale and to what extent the presence of deep-rooting plant species causes re-distribution of permafrost N to the shallower ecosystem and of the microbial community to the deeper, thawing soil layers, and how this affects C-uptake and respiration. To achieve this, we apply for TA-support to establish vegetation manipulation treatments (deep- or shallow-rooting species removal) in a 4-year old permafrost thaw field experiment north of Toolik Field Station. In the new permafrost-thaw x vegetation manipulations, we will monitoring vegetation, microbial, biogeochemical and physical responses (e.g. plant growth, phenology, NDVI, CO2-fluxes, microbial community, temperature, moisture, thaw depth, nutrient availability). Specifically, this TA-project will thus provide estimates of 5th-year permafrost-thaw effects on various plant, microbe and ecosystem processes, and 1st-year data of how this depends on deep-rooting plant species. Further, it will create as legacy a unique, long-term ecosystem manipulation experiment to unravel interactive effects of permafrost thaw and deep-rooting plant species on C and N dynamics.